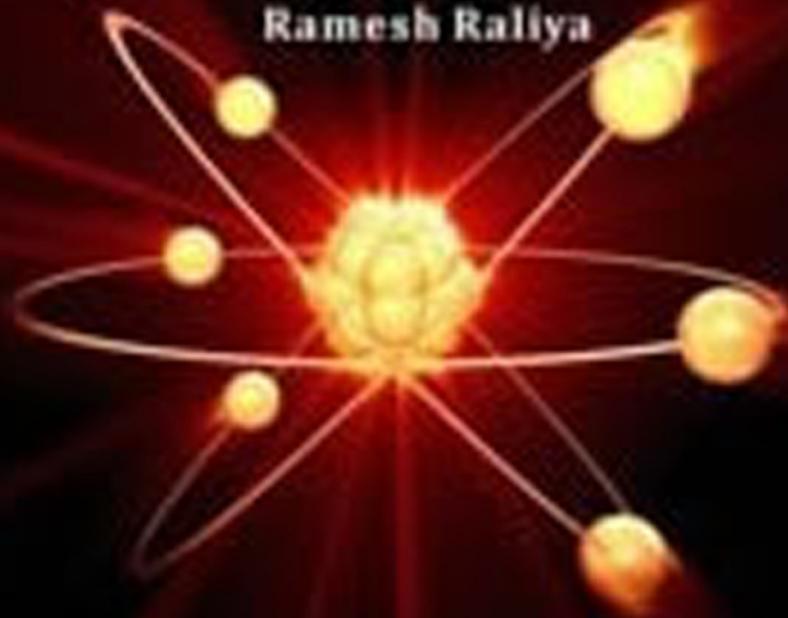


J. C. Tarafdar
Ramesh Raliya



NANOTECHNOLOGY

The Nanotechnology

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FOREWORD

The nanotechnology deals with the very small but the topic itself is huge and complex. Like any technology, it consists of a lot of concepts and touches variety of sciences such as physics, chemistry, mechanical engineering, materials science, and biology. Nanotechnology is simply the study of all things happening on a small scale that produce big (sometimes really big) effects. The use of nanoscale particles with high surface areas has also been exploited for many years in industrial catalysis, and again the preparation of these materials has been used “nanotechnology” in various forms.

This book provides you with just what you need to understand the basic of nanotechnology and its potential. This book doesn't present to answer all questions about nanotechnology because, frankly, nano is so cutting edge that new questions about it are coming up every day. But what here put together gives you a good grounding in the essentials – and makes this exciting area of technology fun! In fact, there is probably not a walk of life that won't be affected by nanotechnology eventually.

Nanotechnology embraces a large of techniques that are used to create and characterize structures on a size scale below ~ 100 nm. The book 'Nanotechnology' is organized so you can quickly find, read, and understands the information you need. It offers the tools to understand and transform bio-systems, solutions to agriculture and food industry, a new platform for new developments and promise of sustainable development in long term. The chapters presented in this book mainly attempted the application aspect of production of nanoparticles and its characterization. Included in these are UV-VIS Spectroscopy, Fourier

Transformer Infrared (FTIR) spectroscopy, Particle size analyzer, Ultra-sonication, Ultra-centrifuge, Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), Inductively coupled plasma mass spectroscopy (ICPMS), X-ray diffraction (XRD), Atomic force microscopy (AFM) and Lithography.

The book encompasses a diverse range of techniques that are the essential tools under-pinning much of nanotechnology. The chapters in this book are divided into parts that help you get right to the information you are looking for. The ultimate purpose of this book is to equip the reader with comprehensive knowledge in nanotechnology with reference to basic and applied aspects. In summary, this book describes the basics and entire characterization techniques that are currently used in studies of nanostructure materials. I hope the book will provide a valuable resource to all involved in the subject and characterization of nanomaterials.



A. K. Singh
Deputy Director General, NRM



FOREWORD

Nanotechnology is a part of any nation's future and has become a new and significant focus for investment in research. The Government of India has launched a mission mode R & D programme in the year 2007 with a budgetary provision of 1000 crores over five years under Nano-Missions Council guided by two advisory groups viz., Nano Science Advisory Group (NSAG) and Nano Science Applications and Technology Advisory Group (NATAG) with a mission for funding research projects to foster and promote the R & D activities in this area in the country. With the current advancement in science and technology, the emerging field of “Nanotechnology” will have a great impact on the overall development of our country. Generally speaking, Nanotechnology refers to the fabrication, manipulation and utilization of submicron objects, particularly those between 1 and 100 nm.

Nanotechnology will enable making high-quality products at a very low cost and at a very fast pace. It is commonly referred to as a generic technology that offers better-built, safer, long lasting, cheap and smart products that will find wide applications in household, communications, medicine as also agriculture and food industry amongst others. Novel agricultural and food security systems, cellular biology, environmental protections, disease treatment and delivery methods etc. are just a few examples where nanotechnology could have important impact. The extraordinary bio-effectiveness of nanoparticles has inturn derived into a strong debate about their potential toxicity, when directly exposed to the human body or released to the environment, which is still unsolved.

Nanotechnology are of great scientific interest as they are effectively a bridge between bulk materials and atomic or molecular structures. It has great scope as nanoparticles are high surface area and high reactivity, effective catalyst of plant/microbial/ animal metabolism, better penetration into the cell, increased plant and biological activities etc. Nanotechnology has enormous potential to apply in natural

resource management, value addition, delivery mechanisms, disease diagnosis, horticultural chain, biodiversity, food processing, human health management etc.

The authors of the book “Nanotechnology” have embarked on a wide range of topics dealing with the basics and techniques to characterize the nanoparticles. This book is a step towards that realization, especially for making the nanotechnology more sustainable. I sincerely hope that this book will serve as a useful text reference for scientist, researchers, and students engaged in pursuit of research and development in Nanotechnology.

A handwritten signature in black ink that reads "Bangali Baboo". The script is cursive and fluid, with the first letter 'B' being particularly large and stylized.

Bangali Baboo
National Director, NAIP

Preface

The field on nanotechnology is still in its infancy but continues to progress at a much faster rate than any other field. Nanotechnology has the potential to revolutionize the scientific world by allowing scientists to manipulate matter at the atomic or molecular scale. It is a broad and interdisciplinary area of research and development activity that has been growing at a rapid pace worldwide in the past few years. It is already having a significant commercial impact, which will certainly increase in the future. It will enable making high-quality products at a very low cost and a very fast pace. It is commonly referred to as a generic technology that offers better-built, safer, long lasting, cheap and smart products that will find wide applications in household, communications, medicine as also agriculture and food industry amongst others. The nano-idea isn't as new as we may first think; it has been present somewhat un-noticed or un-defined in our daily life, already in science fiction as a sort of technology that could allow characters to be or do almost anything and in the movies of the early sixties. Nanoscience surely as one of the hottest areas in contemporary scientific research, there is an every-increasing interest in the field. Currently the main thrust of research in nanotechnology focuses on application like electronics, automation, medicine and life sciences. The experience gained from this could be used to revolutionize the food and agriculture systems. Novel agricultural and food security systems, cellular biology, environmental protections, diseases treatment delivery methods etc. are just a few examples where nanotechnology could have important impact. Many methods to synthesize nano particles and techniques to characterize for exploitation of its extraordinary properties is the goal and dream of researchers engaged in this field. It is not possible to cover everything about nanoparticle and its role in revolution of scientific era. The approach adopted in this book was to focus on nanoparticle characterization techniques. Therefore, the chapters presented in this book addresses principle, sample preparation and applications of technique for nanoparticle characterization besides the basic concept and scope of nanotechnology, synthesize of nanoparticles from different methods and bio-safety and ethical concern related to nanotechnology.

The ultimate purpose of this book is to equip the reader with comprehensive knowledge in Nanotechnology with reference to basic as well as applied aspects. It contains predigested information on nanotechnology for good understanding, assimilation and reproducibility. Although we have made every effort to make the book error free, we are under no illusion. We welcome comments, criticism and suggestions from the readers. We are grateful to Dr. M.M. Roy (Director, CAZRI, Jodhpur) and Indian Council of Agricultural Research (ICAR) for their all round help to bring out this book.

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Ramesh Raliya

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